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especially for users of
CAR BUILDER.

Technical Glossary

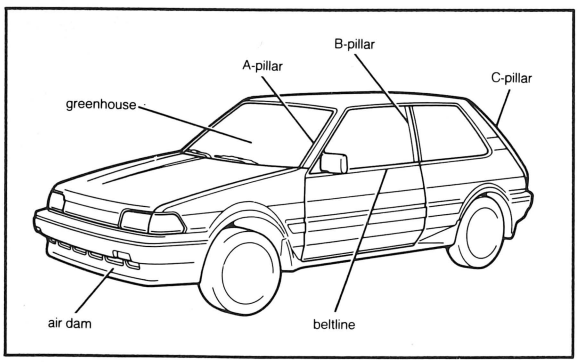
Every automotive term you wanted to know about—but were afraid to ask.

BY CSABA CSERE

• Last March, the *Wall Street Journal* ran a story about how the increasingly common use of high-tech automotive jargon in car commercials is bewildering the public. According to the article, many automotive advertisements use impressive-sounding terms that no one understands to tout technical features and advancements. As proof, the *Journal* interviewed several auto shoppers and asked them to define such terms as "rack-and-pinion steering" and "double wishbones." Their responses were comical, to say the least. The author then proceeded to set the record straight, explaining, among other things, that rack-and-pinion steering consists of a gear that moves back and forth across a toothed rack. Close, but exactly backward.

That got us thinking. We know that *Car and Driver* readers are better informed than average car buyers (and certainly far better informed than *WSJ* reporters). But maybe the *Journal* was on to something. A great deal of new technology has been introduced in the past decade, and much of the terminology used to describe it is complex and difficult to understand.

So, on the off chance that there might be a term or two you can't define in your sleep, we hereby present the first installment of a three-part *Car and Driver* technical glossary. Please note that our definitions relate only to cars: don't write to us saying a "drum brake" is actually something you use to quiet the budding percussionist next door. Note, too, that the **boldface** words within the definitions are themselves defined elsewhere in the glossary. Finally, be sure to keep these pages for future reference. By December you'll have all three parts of the glossary and enough technical wisdom to astonish the members of your local car club. You may even learn enough to consider a career as a *Wall Street Journal* reporter.



A-pillar—the roof support on either side of a car's windshield.

active suspension—an extremely sophisticated, computer-controlled suspension system that uses powered actuators instead of conventional springs and shock absorbers. The actuators position a car's wheels in the best possible manner to deal with road disturbances and **handling** loads.

aerodynamic drag—the drag produced by a moving object as it displaces the air in its path. Aerodynamic drag is a force usually measured in pounds; it increases in proportion to the object's frontal area, its **drag coefficient,** and the square of its speed.

air dam—a front **spoiler** mounted beneath the bumper and shaped to reduce the airflow under the car. Air dams can increase the airflow to radiators, reduce **aerodynamic drag,** and/or reduce **lift.**

anti-dive—a tuned-in front suspension characteristic that converts braking-induced forces in the suspension **links** into a vertical force that tends to lift the body, thereby reducing **dive** under braking.

anti-lock-braking system—a braking system that senses when any of the wheels have locked up, or are about to, and automatically reduces the braking forces to keep the wheels rolling. Commonly called ABS, such a system can control all four wheels or only two.

anti-roll bar—a suspension element (used at the front, the rear, or both ends of a car) that reduces body **roll** by resisting any unequal vertical motion between the pair of wheels to which it is connected. An anti-roll bar does not affect suspension stiffness when both wheels are deflected equally in the same direction. Often incorrectly called a sway bar.

anti-que—a very, very, very old car.

anti-squat—similar to **anti-dive,** this suspension characteristic uses acceleration-induced forces in the rear suspension to reduce **squat.**

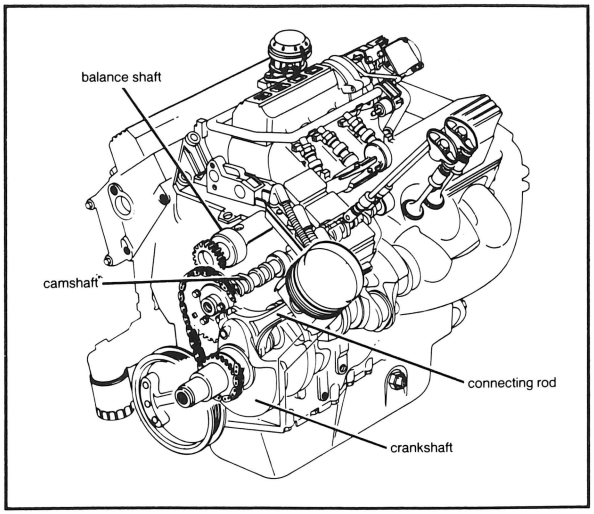
apex—the point(s) or region on the **line** through a corner that touches the corner's inner radius.

aspect ratio—generally the ratio between two dimensions of an object. In tire terminology it applies to the unloaded sidewall height of the tire divided by its overall width. A lower aspect ratio implies a shorter, wider tire. When used to describe a wing it is the span of the airfoil (the long dimension perpendicular to the airflow) divided by its chord (the dimension parallel to the airflow).

axle tramp—a sleazy woman in mechanic's overalls. It's also a form of **wheel hop** that occurs on cars with **live axles,** caused by the axle repeatedly rotating slightly with the wheels and then springing back.

B-pillar—the roof support between a car's front door window and rear side window, if there is one.

balance shaft—a shaft designed so that, as it rotates, it vibrates in a way that reduces or cancels some of the vibration produced by an engine. Not essential to an engine's operation, balance shafts are nonetheless becoming increasingly common as a means of engine refinement. Balance-shafted four-cylinder engines use two shafts turning in opposite directions on either



side of the engine's **crankshaft.** A single balance shaft is used when fitted to three-cylinder and V-6 engines.

ball joint—a flexible joint consisting of a ball in a socket, used primarily in front suspensions because it can accommodate a wide range of angular motion.

beam axle—a **rigid axle** supporting the non-driven wheels. Also called a dead axle.

beltline—the line running around a car's body formed by the bottom edges of its glass panels.

bevel gears—a **gearset** employing gears shaped like slices of a cone, which allows the axes of the gears to be nonparallel. Bevel gears are used to transmit motion through an angle.

boost pressure—the increase above atmospheric pressure produced inside the **intake manifold** by any **supercharger.** It is commonly measured in **psi,** inches of mercury, or bar.

bore—your Uncle Fred. Also, the diameter of a **cylinder.**

brake bias—the front/rear distribution of a car's braking power. For the shortest stopping distance, brake bias should match the car's traction at each end during hard braking.

brake modulation—the process of varying pedal pressure to hold a car's brakes on the verge of **lockup.** Ideally, the brakes will unlock with only a slight reduction in the pressure needed to lock them. Typically, however, a considerable pressure reduction is required.

brake torquing—a procedure generally used in performance tests to improve the off-the-line acceleration of a car equipped with an automatic **transmission.** It is executed by firmly depressing the brake with the left foot, applying the throttle with the car in gear to increase engine rpm, then releasing the brakes. Brake torquing is particularly effective with **turbocharged** cars because it helps overcome **turbo lag.**

breathing (engine)—a term used to describe an engine's ability to fill its **cylinders** with air-fuel mixture and then discharge the burnt exhaust gases. In general, the more air-fuel mixture an engine burns the more **power** it produces.

breathing (heavy)—a typical response when an enthusiast sees any sleek, Italian car with a twelve-cylinder engine.

bushing—a simple suspension bearing that accommodates limited rotary motion, typically made of two coaxial steel tubes bonded to a sleeve of rubber between them. The **compliance** of the bushing in different directions has a great effect on ride **harshness** and **handling.**

C-pillar—the roof support between a car's rearmost side window and its rear window. On a vehicle with four side pillars, the rearmost roof support may be called a D-pillar.

CAD/CAM—computer-aided design and computer-aided manufacturing—the harnessing of computers to generate drawings, perform complex structural and design analyses, and directly program numerically controlled machines to produce automotive parts.

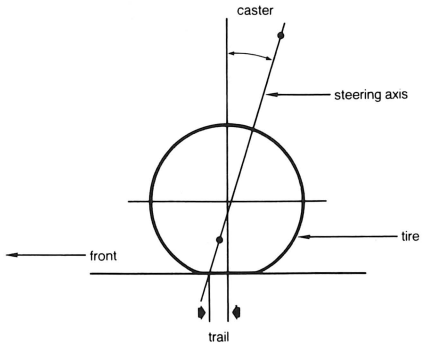
cam profile—the shape of each lobe on a **camshaft.** The profile determines the amount, or "duration," of time the valve is open; it also largely determines the valve's maximum opening, or "lift."

camber—the angle between the plane of a wheel's circumference and a vertical line, measured in degrees and minutes. The tops of a car's wheels tilt inward when the camber is negative, outward when it is positive.

camshaft—a shaft fitted with several cams, whose lobes push on **valve lifters** to convert rotary motion into linear motion. The opening and closing of the valves in all piston engines is regulated by one or more camshafts.

carbon fiber—threadlike strands of pure carbon that are extremely strong in tension (that is, when pulled) and are reasonably flexible. Carbon fiber can be bound in a matrix of plastic resin by heat, vacuum, or pressure to form a **composite** that is strong, light—and very expensive.

caster—the angle between a vertical line and the **steering axis** when viewed from the side, measured in degrees and minutes.



STEERING GEOMETRY

castor oil—a pale, viscous, fatty oil fed to *C/D* writers when they call the editor "Bill."

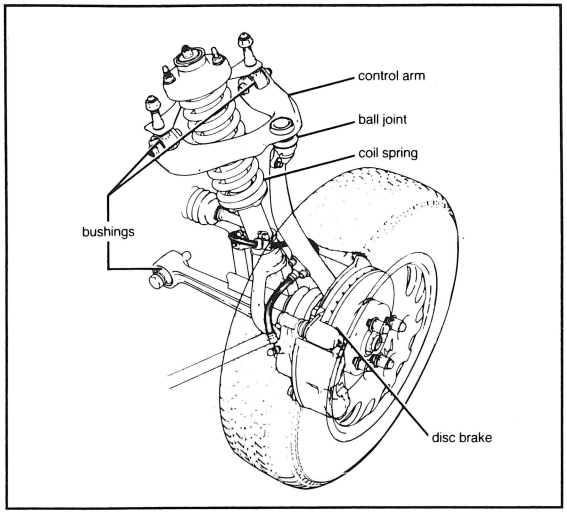
catalytic converter—often simply called a "catalyst"—a stainless-steel canister fitted to a car's exhaust system that contains a thin layer of catalytic material spread over a large area of inert supports. The material used is some combination of platinum, rhodium, and palladium; it induces chemical reactions that convert an engine's exhaust emissions into less harmful products. So-called three-way catalysts are particularly efficient; their operation, however, demands very precise combustion control, which can be produced only by a **feedback fuel-air-ratio control** system.

center differential—a **differential** used in four-wheel-drive systems to distribute power to the front and rear differentials.

center of gravity—the imaginary point in any object about which it is in perfect balance no matter how it is turned or rotated.

chassis—a general term that refers to all of the mechanical parts of a car attached to a structural frame. In cars with **unitized construction,** the chassis comprises everything but the body.

coil spring—a bar of resilient metal wound into a spiral that may be compressed or extended without permanent deformation. Coil springs have many automotive applications but are particularly important as suspension springs.



combustion chamber—the space within the **cylinder** when the piston is at the top of its travel. It is formed by the top of the piston and a cavity in the **cylinder head.** Since most of the air-fuel mixture's combustion takes place in this space, its design and shape can greatly affect the **power,** fuel efficiency, and emissions of the engine.

compliance—a slight resiliency, or "give," designed into suspension **bushings** to help absorb bumps. Good compliance allows the wheels to move rearward a bit as they hit bumps but doesn't allow them to move laterally during cornering.

composite—any material that consists of two or more components, typically one or more of high strength and one an adhesive binder. The most common composite is **fiberglass,** which consists of thin glass fibers bonded together in a plastic matrix. The structural properties of composites can be altered by controlling the orientation and configuration of the high-strength components.

compression ratio—the ratio between the combined volume of a **cylinder** and a **combustion chamber** when the piston is at the bottom of its stroke, and the volume when the piston is at the top of its stroke. The higher the compression ratio, the more mechanical energy an engine can squeeze from its air-fuel mixture. Higher compression ratios, however, also make **detonation** more likely.

connecting rod—the metal rod that connects a piston to a throw on a **crankshaft.**

constant-velocity joint—a particular kind of **universal joint** designed so that there is no cyclic fluctuation between the speeds of its input and output shafts.

contact patch—the portion of a tire tread that is in contact with the road. On modern tires, it varies from nearly a circle to a wide ellipse.

control arm—a suspension element that has one joint at one end and two joints at the other end, typically the **chassis** side. Also known as a wishbone or an A-arm.

convertible—a car whose top can be completely lowered.

cornering limit—the maximum speed at which a car can negotiate a given curve.

coupe—a closed car with two side doors and less than 33 cubic feet of rear interior volume, according to measurements based on **SAE** standard J1100. A two-door car is therefore not necessarily a coupe.

crankshaft—a shaft with one or more cranks, or "throws," that are coupled by **connecting rods** to the engine's pistons. Together, the crankshaft and the con rods transform the pistons' reciprocating motion into rotary motion.

crash—generally a high-speed parking maneuver. Often, the driver at fault will refer to it as a "shunt" or an "incident."

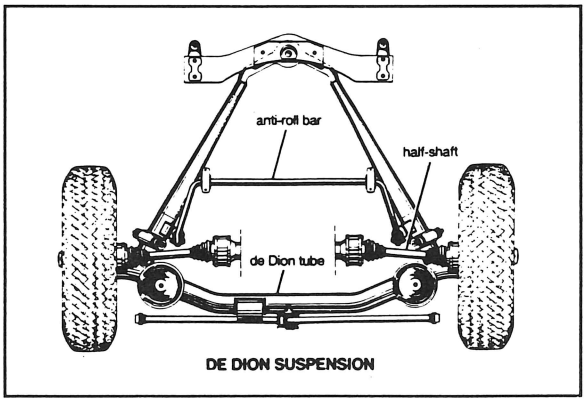
cylinder—the round, straight-sided cavity in which the pistons move up and down. Typically made of cast iron and formed as a part of the block.

cylinder head—the aluminum or iron casting that houses the **combustion chambers,** the **intake and exhaust ports,** and much or all of the **valvetrain.** The head (or heads, if an engine has more than one bank of cylinders) is always directly above the **cylinders.**

cylinder liner—the circular housing that the piston moves in when the cylinder is not an integral part of the block. Also known as a "sleeve."

dBA—a unit of measure for decibels, the measure of sound intensity or pressure named after Alexander Graham Bell. It is a logarithmic measurement; every 3dB increase represents a doubling of the sound pressure. The "A" in dBA indicates that the measurement was taken with an A-weighted scale; sound pressure varies across the audible spectrum, and the A-weighted scale approximates the human ear's sensitivity to various frequencies.

de Dion suspension—a suspension system in which the rear, driven wheels are bolted to a transverse, lightweight, rigid member. Power is delivered to the wheels by universal-jointed **half-shafts** attached to a body-mounted **differential.**



DE DION SUSPENSION

dead pedal—a footrest found to the left of the leftmost pedal. It provides a place for the driver to brace his left leg during hard cornering.

detonation—a condition in which, after the spark plug fires, some of the unburned air-fuel mixture in the **combustion chamber** explodes spontaneously, set off only by the heat and pressure of air-fuel mixture that has already been ignited. Detonation, or "knock," greatly increases the mechanical and thermal stresses on the engine.

differential—a special gearbox designed so that the **torque** fed into it is split and delivered to two outputs that can turn at different speeds. Differentials within axles are designed to split torque evenly; however, when used between the front and rear axles in four-wheel-drive systems (a **center differential**), they can be designed to apportion torque unevenly.

disc brakes—properly called caliper disc brakes—a type of brake that consists of a disc that rotates at wheel speed, straddled by a caliper that can squeeze the surfaces of the disc near its periphery. Disc brakes provide a more linear response and operate more efficiently at high temperatures than **drum brakes.**

dive—the dipping of a car's nose that occurs when the brakes are applied. Dive is caused by a load transfer from the rear to the front suspension; this transfer occurs because the car's **center**

of gravity, through which all inertial forces pass, is higher than its **contact patches,** the points where the braking forces are exerted on the ground.

DOHC—double overhead **camshaft**—a DOHC engine has two camshafts in each **cylinder head;** one camshaft operates the intake valves, the other actuates the exhaust valves.

downforce—a vertical force directed downward, produced by airflow around an object—such as a car body.

drag coefficient—a dimensionless measure of the aerodynamic sleekness of an object. A sleek car has a drag coefficient, or "Cd," of about 0.30; a square, flat plate's is 1.98. Also signified by Cx.

drivability—the general qualitative evaluation of a **powertrain's** operating qualities, including idle smoothness, cold and hot starting, throttle response, power delivery, and tolerance for altitude changes.

driveline—everything in the **drivetrain,** less the engine and the **transmission.**

driveshaft—the shaft that transmits **power** from the **transmission** to the **differential.**

drivetrain—all of a car's components that create power and transmit it to the wheels; i.e. the engine, the **transmission,** the **differential(s),** the hubs, and any interconnecting shafts.

drum brakes—a type of brake that has an iron casting shaped like a shallow drum that rotates with the wheel. Curved brake shoes are forced into contact with the inner periphery of this drum to provide braking.

EGR—exhaust-gas recirculation—a method of reducing NOx (oxides of nitrogen) exhaust emissions by recirculating some of the engine's exhaust gas into the **intake manifold.** The exhaust gas serves as inert filler that absorbs heat during the combustion process and reduces the peak temperature reached during combustion.

engine-control system—a computerized brain that regulates an engine's operation by monitoring certain engine characteristics (rpm, coolant temperature, intake airflow, etc.) through a network of sensors and then controlling key variables (fuel metering, spark timing, EGR, etc.) according to pre-programmed schedules.

EPA fuel economy—laboratory fuel-economy tests administered by the Environmental Protection Agency using simulated weight and drag to re-create real driving conditions. The city fuel-economy test, also used to test emissions compliance, is based on a drive through typical Los Angeles urban traffic of about twenty years ago. The highway test uses a higher, steadier speed, averaging 49.4 mph.

exhaust manifold—the network of passages that gathers the exhaust gases from the various **exhaust ports** and routes them toward the **catalysts** and mufflers of the exhaust system. A manifold with free-flowing passages of a carefully designed configuration, called a "header," can improve **breathing.**

exhaust port—the passageway in the **cylinder head** leading from the exhaust valves to the **exhaust manifold.**

feedback fuel-air-ratio control—a feature of a computer-controlled fuel system. By using a sensor to measure the oxygen content of the engine's exhaust, the system keeps the fuel-air ratio very close to the proportion for chemically perfect combustion. Such tight control of the fuel-air ratio is mandatory for the proper operation of three-way **catalysts.**

fiberglass—a **composite** material that relies on small glass fibers for its strength.

final-drive ratio—the reduction ratio, found in the **gearset** of a **drivetrain,** that is furthest removed from the engine. Typically, the **differential** ratio.

floorpan—the largest and most important stamped metal part in a car's body. Usually assembled from several smaller stampings, the floorpan forms the floor and fixes the dimensions for most of the car's external and structural panels. It is also the foundation for many of the car's mechanical parts.

fluid coupling—any device that transfers power through a fluid between its inputs and outputs. A fluid coupling basically consists of two fans in a sealed, oil-filled housing. The input fan churns the oil, and the churning oil in turn twirls the output fan. Such a coupling allows some speed difference between its input and output shafts.

flywheel—a heavy disc attached to an engine's **crankshaft** to increase its rotary inertia, thereby smoothing its power flow.

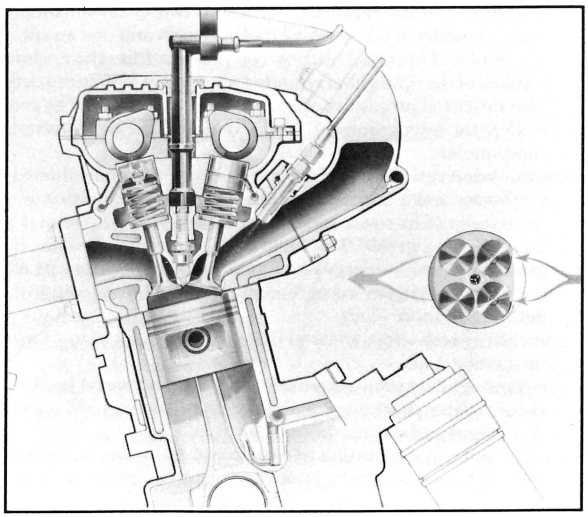
four valves per cylinder—a **valvetrain** with a total of four valves in the **combustion chamber,** typically two intakes and two exhausts. Compared to the more common two-valve-per-cylinder designs, a four-valve layout offers improved **breathing** and allows the spark plug to be located closer to center of the combustion chamber.

four-wheel drift—a somewhat imprecise term that describes a cornering situation in which all four tires are operating at large **slip angles.**

four-wheel steering—a steering system that actively steers the rear wheels as well as the fronts to improve **handling** and maneuverability.

fourteen-wheel steering—a stunning, high-speed maneuver that occurs when a large semi truck experiences four simultaneous blowouts while driving down a steep hill in the rain.

fuel injection—any system that meters fuel to an engine by measuring its needs and then regulating the fuel flow, by electronic or mechanical means, through a pump and injectors. **Throttle-body** injection locates the injector(s) centrally in the throttle-body housing, while port injection allocates at least one injector for each **cylinder** near its **intake port.**



Technical Glossary, Part II

Defined: every automotive term you need to know, from "g" to "rubber-isolated crossmember."

BY CSABA CSERE

• Last month, we presented Part I of our three-part *Car and Driver* Technical Glossary. We hope you've been studying hard, because—as promised—here is Part II. If you read the definitions carefully, you should have a much better understanding of today's complex automotive terms. Never again will you confuse a "redline" with something you get when you remove a tight pair of BVDs.

Remember to save these pages. Our glossary works best as a whole: many of the definitions that follow have words highlighted in **boldface** that are themselves defined elsewhere in the glossary. Remember, too, that our definitions relate only to cars: we don't care if you think a "greenhouse" is a humid room used to cultivate plants and amorous late-night rendezvous.

If you did as you were told and saved Part I in your automotive archives, you now have two-thirds of your guide to Total Automotive Enlightenment. Commit these pages to memory, and you'll be ready to receive that heady state of car consciousness next month.

g—the unit of measure for lateral acceleration, or **"roadholding."** One g is equivalent to 32.2 feet per second per second, the rate at which any object accelerates when dropped at sea level. If a car were cornering at 1.0 g—a figure that very few production cars are able to approach—the driver's body would be pushing equally hard against the side of the seat as against the bottom of it.

gearset—a group of two or more gears used to transmit **power.**

greenhouse—the portion of a car's body that rises above the **beltline.**

ground effect—the phenomenon that occurs when the airflow between a moving object and the ground creates **downforce.**

half-shaft—an articulating, rotating shaft used in **independent-suspension** systems to transmit **power** from a **differential** to a wheel.

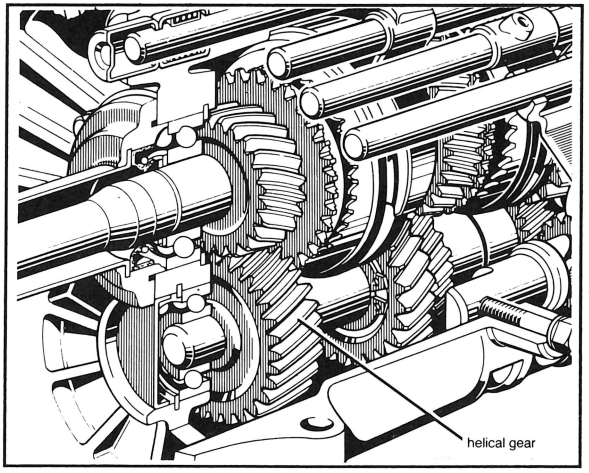
handling—a general term covering all the aspects of a car's behavior that are related to its directional control.

harshness—the aspect of a car's ride roughness that is characterized by small, sharp jolts.

heel-and-toe—a performance-oriented technique of downshifting while braking that requires the driver to use all three pedals of a manual-transmission car simultaneously. To perform a heel-and-toe downshift, the driver brakes with the toe of his right foot and—while continuing to brake—uses the heel or the side of the same foot to blip the throttle and raise engine rpm as he downshifts. The left foot operates the clutch pedal in the normal fashion. The sequence is as follows: brake with the right toe; depress the clutch with the left foot; shift to neutral; while continuing to brake, blip the throttle with the side or the heel of the right foot to raise rpm; shift to a lower gear; let the clutch out; release the brakes. The technique is difficult to master, but after practice it can be performed in less than a second.

heim joint—an extremely rigid articulating joint, commonly known as a "spherical rod-end," used in any precision linkage. Heim joints are often used in the suspension **links** of race cars because they locate wheels very precisely.

helical gear—a type of gear in which the teeth are cut at a slanting angle to the gear's circumference. A helical design produces an even, constant tooth loading in a **gearset,** thereby reducing noise.



hemi—a term used to describe any engine that has hemispherical **combustion chambers** in its **cylinder head.** Although a **four-valve** design is more efficient, a hemi head provides room for a pair of large valves and offers good **breathing** characteristics.

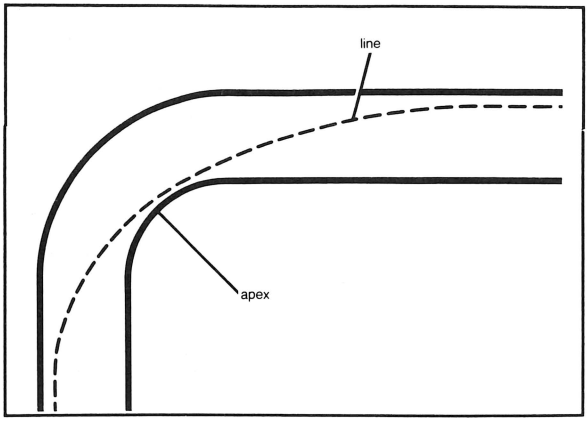
horsepower—the common unit of measurement of an engine's **power.** One horsepower equals 550 foot-pounds per second, the power needed to lift 550 pounds one foot off the ground in one second—or one pound 550 feet up in the same time.

Hotchkiss suspension—a **live-axle** rear suspension in which **leaf springs** handle both the axle's springing and its location.

hydraulic lifter—a **valve lifter** that, using simple valving and the engine's oil pressure, can adjust its length slightly—thereby maintaining zero clearance in the **valvetrain.** Hydraulic lifters reduce valvetrain noise and are maintenance-free.

independent suspension—any suspension in which the **camber** of a wheel is not directly affected by the vertical motion of the opposite wheel.

instruments—the displays on the dashboard that communicate information about the mechanical operation of the car to the



driver. Mechanically controlled instruments almost always feature analog displays (usually needles-and-numbers dials). Electronically controlled instruments use analog displays, digital readouts, or even graphics panels.

intake charge—the mixture of fuel and air that flows into the engine.

intake manifold—the network of passages that direct air or air-fuel mixture from the **throttle body** to the **intake ports** in the **cylinder head.** The flow typically proceeds from the throttle body into a chamber called the **plenum,** which in turn feeds individual tubes, called runners, leading to each intake port. Engine **breathing** is enhanced if the intake manifold is configured to optimize the pressure pulses in the intake system.

intake port—the passageway in a **cylinder head** leading from the **intake manifold** to the intake valve(s).

intercooler—a heat exchanger that cools the air (or, in some installations, the **intake charge**) that has been heated by compression in any type of **supercharger.** An intercooler resembles a radiator; it houses large passages for the intake flow, and uses either outside air or water directed over it to lower the temperature of the intake flow inside.

jounce—the motion of a wheel that compresses its suspension.

jounce bumper—an elastic cushion used to stiffen the suspension gradually as it approaches the end of its **jounce** travel.

Kevlar—a very flexible, strong, light, and abrasion-resistant artificial fiber, manufactured by Du Pont, that can be combined with a plastic resin to produce an efficient **composite** material.

kickdown—a downshift in an automatic **transmission** caused by depressing the throttle.

knock sensor—a sensor mounted on the engine that is designed to detect the high-frequency vibrations caused by **detonation.** By employing a knock sensor, a computerized **engine-control system** allows an engine to operate very near its detonation limit—thereby improving **power** and efficiency.

lateral link—a suspension **link** that is aligned to resist sideways motions in a wheel.

leading link—a suspension **link** that is aligned to resist longitudinal motions in a wheel; it is mounted to the **chassis** behind the wheel.

leaf spring—a long, flat, thin, flexible piece of spring steel or various **composite** materials that deflects by bending when forces act upon it. Leaf springs are used primarily in suspensions.

lift—a vertical force directed upward, produced by the airflow around a moving object—such as a car body.

lift-throttle oversteer—a **handling** characteristic that causes the rear tires to lose some of their cornering grip when the throttle is released during hard cornering.

limited-slip differential—a **differential** fitted with a mechanism that limits the speed and **torque** differences between its two outputs. Limited slip ensures that some torque is always distributed to both wheels, even when one is on very slippery pavement.

line—a lecherous phrase, such as "Hey, baby, have you seen the mags on my '71 Challenger R/T?" Also, the path through a corner that best accommodates a late braking point, a high cornering speed, and the fastest-possible exit speed.

link—a suspension member that has a single joint at each end.

live axle—a **rigid axle** incorporating a **differential** and axle shafts to power the two wheels it is supporting.

lockup—the juncture at which a tire starts to skid during braking. A tire's maximum braking force is developed when it is on the verge of lockup, so a car's shortest stopping distances are produced when its front and rear tires approach lockup simultaneously. This is very hard to achieve under varying conditions of load and traction, so one end typically locks up before the other. Front-wheel lockup is inherently more stable than rear-wheel lockup.

lockup differential—a **differential** whose two outputs can be locked together, eliminating any differential action but maximizing traction under slippery conditions.

lockup torque converter—a **torque converter** fitted with a lockup clutch that can be engaged to eliminate the slip between the torque converter's input and output, thereby improving fuel efficiency and performance.

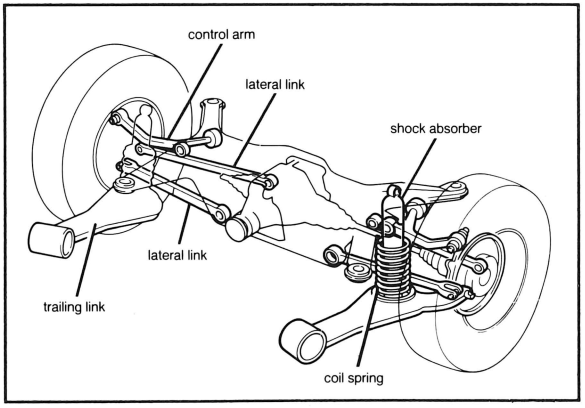
loose—a slang term for **oversteer.** Also . . . well, you know.

main bearings—the bearings in an engine block that support the **crankshaft.**

mid-engine—a **chassis** layout that positions the engine behind the passenger compartment but ahead of the rear axle.

monocoque—a type of body structure that derives its strength and rigidity from the use of thin, carefully shaped and joined panels, rather than from a framework of thick members. Also called "unit" or **"unitized construction."**

multileaf spring—a **leaf spring** with several leaves bundled together.

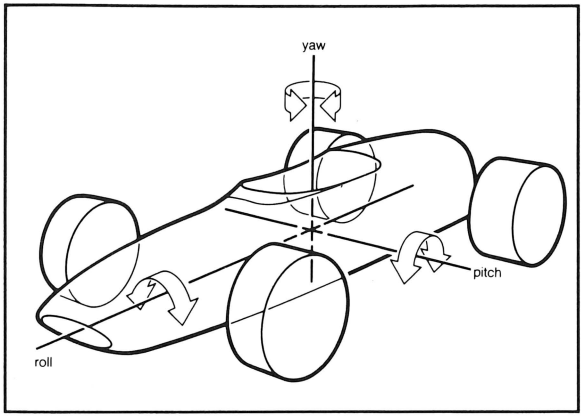


MULTILINK SUSPENSION

multilink suspension—a rear suspension consisting of at least four **links,** or "arms," and no **struts.** Because multilink suspensions assign specific wheel-locating duties to each element, they provide great flexibility for optimizing both ride and **handling.**

neutral steer—a cornering condition in which the front and rear **slip angles** are roughly the same. Although seemingly an ideal state of balance, perfect neutral steer is not as stable as slight **understeer.**

on-center feel—the responsiveness and feel of the steering when the wheel is approximately centered. In a car with good on-



center feel, the steering wheel tends to return to center when slightly deflected, assisting straight-line stability.

opposite lock—a technique in which the steering wheel is turned in the direction away from where the car is turning. Opposite lock is used to control a car when it is **oversteering** and its tail is swinging wide.

overdrive—any **gearset** in which the output shaft turns faster than the input shaft. Overdrive gears are used in most modern **transmissions** because they reduce engine rpm and improve fuel economy. Occasionally, a separate gearbox with an overdrive gearset is coupled to a conventional transmission.

overhead cam—the type of **valvetrain** arrangement in which the engine's **camshaft(s)** is in its **cylinder head(s).** When the camshaft(s) is placed close to the valves, the valvetrain components can be stiffer and lighter, allowing the valves to open and close more rapidly and the engine to run at higher rpm. In a single-overhead-cam (**SOHC**) layout, one camshaft actuates all of the valves in a cylinder head. In a double-overhead-camshaft (**DOHC**) layout, one camshaft actuates the intake valves, and one camshaft operates the exhaust valves.

oversquare—Pat Boone. Also, a description of an engine whose **bore** is larger than its **stroke.**

oversteer—a **handling** condition in which the **slip angles** of the rear tires are greater than the slip angles of the front tires. An oversteering car is sometimes said to be **"loose,"** because its tail tends to swing wide.

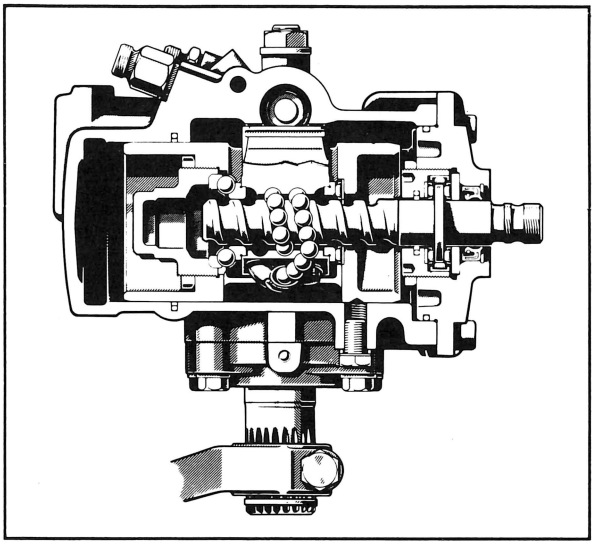
Panhard rod—a long **lateral link** that provides lateral location of a **rigid axle.** It usually sits roughly parallel to the axle, with one end attached to the body and the other attached to the axle.

pent-roof—a **combustion chamber** whose upper surface resembles a shallow peaked roof. Usually used with **four valves per cylinder.**

pitch—the rotation of a car about a horizontal axis, which causes its nose or tail to bob up and down. **Dive** and **squat** are pitching motions.

planetary gears—a **gearset** in which all of the gears are in one plane, grouped around each other like the planets around the sun. The central gear is called the "sun gear." In mesh with it is a circular grouping of gears, called "planet gears," mounted on a rotating carrier. The planet gears also engage teeth on the inner periphery of the "ring gear." By holding any one of the three gear elements motionless, different ratios can be produced between the other two. Planetary gearsets are common in automatic **transmissions.**

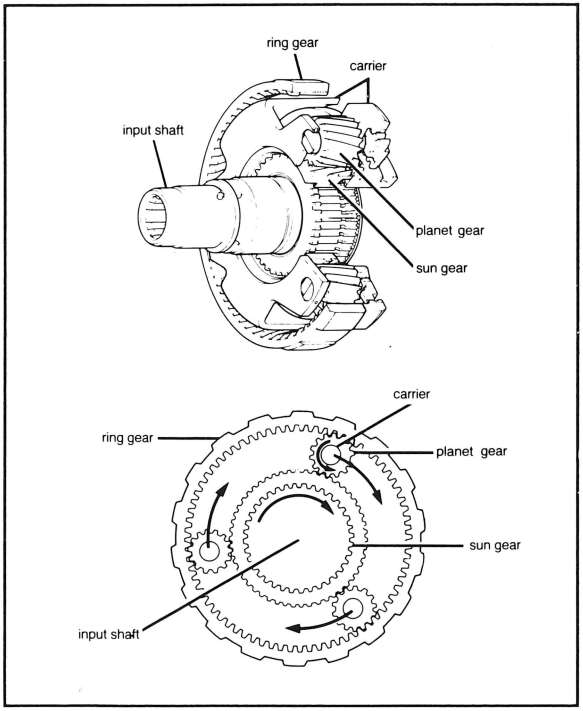
plenum chamber—a chamber, located between the **throttle body** and the runners of an **intake manifold,** used to distribute the **intake charge** evenly and to enhance engine **breathing.**



RECIRCULATING-BALL STEERING

polar moment of inertia—the resistance of an object to rotational acceleration. When the mass of an object is distributed far from its axis of rotation, the object is said to have a high polar moment of inertia. When the mass distribution is close to the axis of rotation, it has a low polar moment of inertia. A **mid-engined** car has most of its mass within its wheelbase, contributing to a low polar moment of inertia, which, in turn, improves cornering **turn-in.**

port fuel injection—the phenomenon that occurs when sailors go ashore for dinner. Also, a type of **fuel injection** with at least



PLANETARY GEARSET

one injector mounted in the **intake port(s)** of each **cylinder.** Port fuel injection improves fuel distribution and allows greater flexibility in **intake-manifold** design, which can contribute to improved engine **breathing.**

pound-feet—the unit of measurement for **torque.** One pound-foot is equal to the twisting force produced when a one-pound force is applied to the end of a one-foot-long lever.

power—the rate at which work is performed. Power is proportional to **torque** and rpm and is measured in **horsepower.**

power band—the subjectively defined rpm range over which an engine delivers a substantial fraction of its peak **power.** The power band usually extends from slightly below the engine's **torque** peak to slightly above its power peak.

powertrain—an engine and **transmission** combination.

profile—the **aspect ratio** of a tire.

progressive-rate spring—a spring with an increasing spring constant. For example, if the first inch of spring motion requires 100 pounds of force, the second inch would require more than an additional 100 pounds, and the third inch would require still more. Progressive-rate springs become stiffer as they are compressed, unlike **single-rate springs,** which have a fixed spring rate.

psi—pounds per square inch, the common unit of measurement for pressure. Atmospheric pressure at sea level is 14.7 psi.

push—a slang term for **understeer.**

pushrod—a hot rod with a broken engine. Also, a general term for any rod that transfers force in compression. In a **valvetrain,** pushrods are used to transfer reciprocating motion from the cam followers to a more distant part of a valvetrain, typically the rocker arms.

rack-and-pinion—a steering mechanism that consists of a gear in mesh with a toothed bar, called a "rack." The ends of the rack are linked to the steered wheels with tie rods. When the gear is rotated by the steering shaft, it moves the rack from side to side—turning the wheels.

rebound—the motion of a wheel that extends the suspension. The opposite of **jounce.**

recirculating-ball—a steering mechanism in which the steering shaft turns a worm gear that, in turn, causes a toothed metal block to move back and forth. Ball bearings in a recirculating track reduce friction between the worm gear and the block. As the block moves, its teeth rotate a gear connected to a steering arm, which then moves the steering linkage.

redline—the maximum recommended revolutions per minute for an engine. In cars equipped with a tachometer—an instrument that measures engine rpm—the redline is usually indicated by, surprisingly enough, a red line. Some tachometers mark the redline with a colored sector. Others have two lines: the lower one marking the maximum allowable sustained engine rpm, the higher line indicating the absolute maximum rpm.

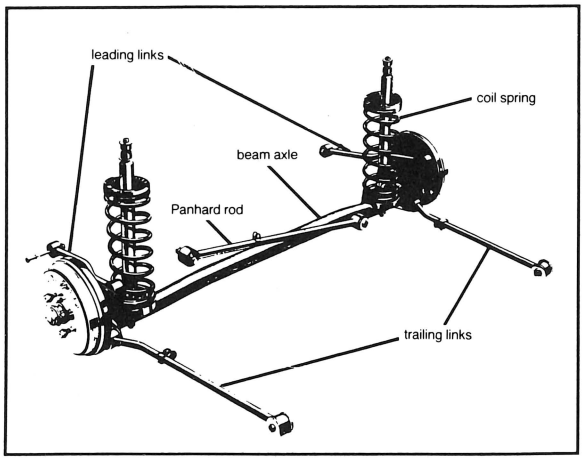
ride height—a measurement between the ground and some fixed reference point on a car's body (the reference point varies according to the whims of the particular automaker). This dimension can be used to measure the amount of suspension deflection or the height of the body from the ground.

ride steer—a generally undesirable condition in which a wheel steers slightly as its suspension compresses or extends. Also called "bump steer."

rigid axle—a simple non-**independent suspension,** consisting of a rigid transverse member with wheel hubs solidly bolted to it. The axle can be attached to the body by **leaf springs,** or by a combination of suspension arms and **links.**

ring-and-pinion gear—any **gearset** consisting of a small gear (the pinion gear) which turns a large-diameter annular gear (the ring gear).

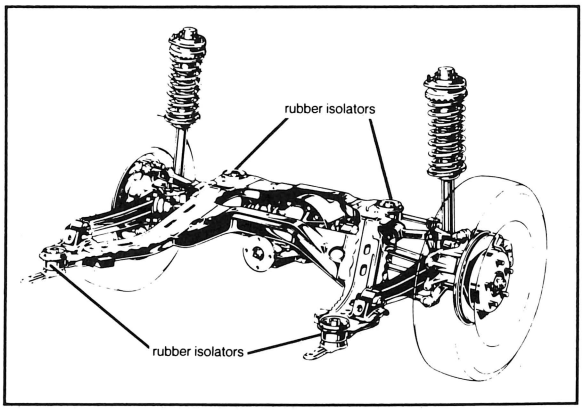
roadholding—the ability of a car to grip the pavement. Technically described as "lateral acceleration," because cornering is actually a continuous deviation from a straight path. Measured in **gs.**



RIGID-AXLE REAR SUSPENSION

road-load horsepower—the amount of power at the driving wheels needed to move a car down the road at a steady speed. This power varies according to the car's speed, **aerodynamic drag,** and mechanical friction, as well as the tires' rolling resistance. Road-load horsepower is distinct from engine **power** because the output of the engine is sapped by various mechanical losses between the engine's output at its **flywheel** and the driving wheels.

roll—the rotation of a car's body about a longitudinal axis. Also less accurately called "sway" or "lean," it occurs in corners because the car's **center of gravity** is almost always higher than the axis about which it rotates.



RUBBER-ISOLATED CROSSMEMBER

rubber-isolated crossmember—a laterally aligned strucural member that is attached to the body or the frame via vibration-absorbing rubber isolators. By bolting suspension or **driveline** components to such crossmembers, automotive engineers can reduce the transmission of noise and/or ride **harshness** to the body.

Well, you've made it through Part II. By now you're well on your way to knowing everything you've always wanted to know about cars. Stay tuned, because we'll have Part III in our December issue. And then you'll have *all* the answers. ●

Technical Glossary, Part III

The last words, including such heart-stoppers as "sump" and "yaw."

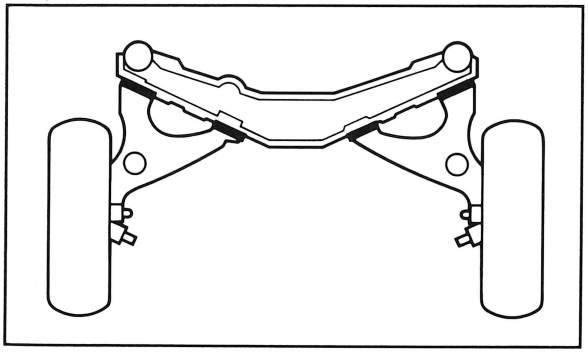
BY CSABA CSERE

• If you're a regular reader of this journal you already know all about our three-part *Car and Driver* Technical Glossary. And you've probably been waiting hungrily for the final installment. Well, here it is. Read and learn.

In case you've just tuned in, there's a reason behind our Noah Webster impersonation. The auto world is becoming increasingly sophisticated, and many automakers are now using complicated terms in their advertisements to tout new technical advancements. Unfortunately, few of the auto shoppers who read those ads know what the terms mean.

That's where we come in. We've prepared this three-part glossary to define those hard-to-understand terms. Parts I and II appeared in our last two issues, so you'll need to dig out your old copies of *C/D* to complete your glossary. If you've missed the last two issues—shame on you—you'll need to Xerox the crucial pages at your local library. Having the entire glossary at hand is helpful, because the **boldface** words within the definitions are themselves defined elsewhere in the glossary.

But let's not waste any more time here. You want answers! Here's Part III.



SEMI-TRAILING-ARM SUSPENSION

SAE—Society of Automotive Engineers—the professional association of transportation-industry engineers. The SAE sets most auto-industry standards for the testing, measuring, and designing of automobiles and their components.

scrub radius—the distance from the point where the **steering axis** intersects the ground to the longitudinal line that runs through the center of the tire's **contact patch.** Also called "steering offset."

sedan—as used by *Car and Driver,* the term "sedan" refers to any fixed-roof car with at least four doors or any fixed-roof two-door car with at least 33 cubic feet of rear interior volume, according to measurements based on **SAE** standard J1100.

semi-elliptic leaf spring—a slightly curved **leaf spring** that is attached to a car's body at its ends and to a suspension component near its middle. One of the two body attachments is a shackle, which allows for changes in the spring's length as it flexes.

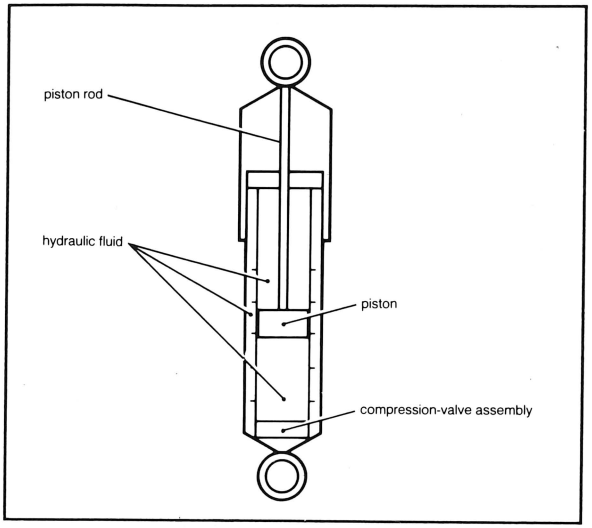
semi-trailing-arm suspension—an **independent** rear-suspension system in which each wheel hub is located only by a large, roughly triangular arm that pivots at two points. Viewed from the top, the line formed by the two pivots is somewhere between parallel and perpendicular to the car's longitudinal axis.

series (tire)—the numerical representation of a tire's **aspect ratio.** A 50-series tire has an aspect ratio of 0.50.

shift gate—the mechanism in a **transmission** linkage that controls the motion of the gearshift lever. The shift gate is usually an internal mechanism; however, in some transmissions—including Ferrari five-speeds and Mercedes-Benz automatics—the shift gate is an exposed guide around the shift lever.

shock absorber—a device that converts motion into heat, usually by forcing oil through small internal passages in a tubular housing. Used primarily to dampen suspension oscillations, shock absorbers respond to motion; their effects, therefore, are most obvious in transient maneuvers. Shock absorbers have no effect during steady-state conditions.

single-rate spring—a spring with a constant spring rate. For example, if a 100-pound force deflects the spring by one inch, an additional 100 pounds will deflect it one more inch, and so on



SHOCK ABSORBER

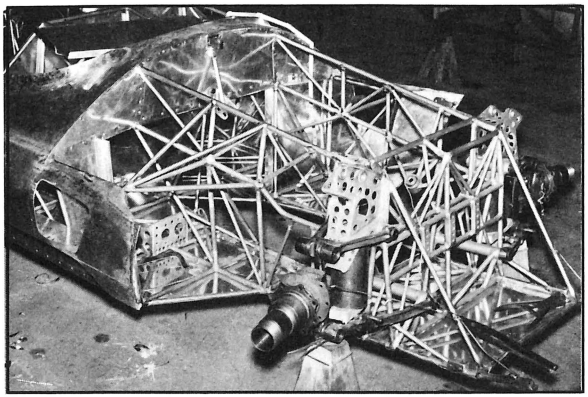
until the spring either bottoms or fails.

skidpad—a large area of smooth, flat pavement used for various **handling** tests. **Roadholding** is measured by defining a large-diameter circle (*Car and Driver* uses 300 feet) on the skidpad and measuring the fastest speed at which the car can negotiate the circle without sliding off.

slip angle—the angular difference between the direction in which a tire is rolling and the plane of its wheel. Slip angle is caused by deflections in the tire's sidewall and tread during cornering. A linear relationship between slip angles and cornering forces indicates an easily controllable tire.

slushbox—a Detroit-area junker rusted out by many winters and filled with equal parts salt and snow. Also slang for an automatic **transmission.**

SOHC—single overhead **camshaft**—an SOHC engine uses one camshaft in each **cylinder head** to operate both the exhaust valves and the intake valves.



SPACE FRAME

space frame—a particular kind of **tube frame** that consists exclusively of relatively short, small-diameter tubes. The tubes are welded together in a configuration that loads them primarily in tension and compression.

spoiler—an aerodynamic device that changes the direction of airflow in order to reduce **lift** or **aerodynamic drag** and/or improve engine cooling.

squat—the opposite of **dive,** squat is the dipping of a car's rear end that occurs during hard acceleration. Squat is caused by a load transfer from the front to the rear suspension.

steering axis—the line that intersects the upper and lower steering pivots on a steered wheel. On a car with a **strut** suspension, the steering axis is defined by the line through the strut mount on top and the **ball joint** on the bottom.

steering feel—the general relationship between forces at the steering wheel and **handling.** Ideally, the steering effort should increase smoothly as the wheel is rotated away from center. In addition, the steering effort should build as the cornering forces at the steered wheels increase. Finally, the friction built into the steering mechanism should be small in comparison with the handling-related steering forces.

steering gain—the relationship between **yaw** and the steering wheel's position and effort. All three should be proportional and should build up smoothly.

steering geometry—the group of design variables outside the steering mechanism that affect steering behavior, including **camber, caster,** linkage arrangement, **ride steer, scrub radius, toe-in,** and trail.

steering response—a subjective term that combines **steering feel** and **steering gain.**

straight-line tracking—the ability of a car to resist road irregularities and run in a straight line without steering corrections.

stroke—someone who can't downshift and chew gum at the same time. Also, the distance between the extremes of a piston's travel in a **cylinder.**

strut—a suspension element in which a reinforced **shock absorber** is used as one of the wheel's locating members, typically by solidly bolting the wheel hub to the bottom of the strut.

sump—the space in the engine block under the **crankshaft** into which the oil drains from its various applications.

supercharger—an air compressor used to force more air into an engine than it can inhale on its own. The term is frequently applied only to mechanically driven compressors, but it actually encompasses all varieties of compressors—including **turbochargers.**

targa—a removable-roof body style popularized by Porsche that is similar to a **convertible** except that it incorporates a fixed, roll-bar-like structure running from side to side behind the front seats.

throttle-body—a housing containing a valve to regulate the airflow through the **intake manifold.** The throttle-body is usually located between the air cleaner and the **intake plenum.**

throttle-body fuel injection—a form of **fuel injection** in which the injectors are located at the engine's **throttle-body,** thereby feeding fuel to more than one **cylinder.** Such an arrangement saves money by using fewer injectors; but because it routes both fuel and air through the **intake manifold,** it eliminates some of the tuning possibilities offered by **port fuel injection.**

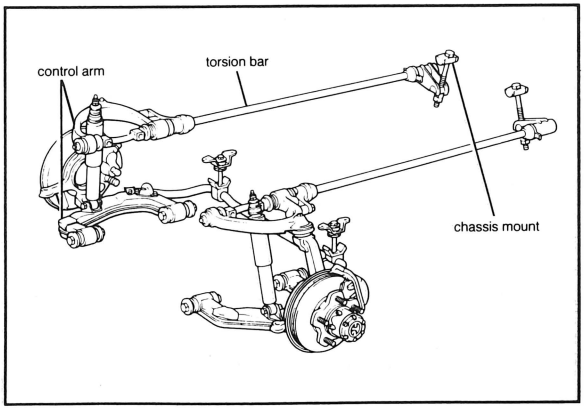
toe-control link—a **lateral link** in a **multilink suspension** designed to control a wheel's direction as the suspension moves up and down.

toe-in—the intentional nonparallel orientation of opposite wheels. Toe-in is measured by subtracting the distance between the front edges of a pair of tires from the distance between the rear edges of the same pair of tires. The toe-in dimension is positive when the fronts of the tires are turned toward the center of the car.

toe steer—the changes in the direction of a wheel that occur without driver steering input. Toe steer can be caused by **ride steer** or by deflections in suspension components caused by the stresses of cornering, accelerating, and/or braking.

torque—the rotational equivalent of force, measured in **pound-feet.**

torque converter—a particular kind of **fluid coupling** with a third element added to the usual input and output turbines. Called "the stator," this additional element redirects the churning fluid against the output turbine, increasing **torque.** This torque increase, however, is achieved at the expense of rpm and efficiency.



TORSION-BAR SUSPENSION

torque steer—a tendency for a car to turn in a particular direction when **power** is applied. Torque steer is common in front-drive cars because reaction forces created in the **half-shafts** can generate uneven steering forces in the front tires.

torsion bar—a spring consisting of a long solid or tubular rod with one end fixed to the chassis and the other twisted by a lever connected to the suspension.

traction control—an electronic control system that prevents wheelspin by detecting when a driven wheel is about to break traction, and then reducing engine **power** and/or applying the appropriate brakes to prevent it.

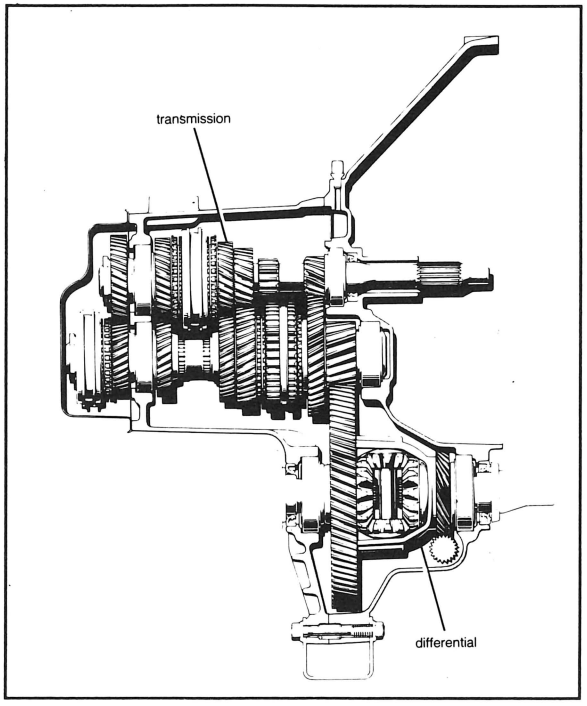
trail-braking—a driving technique in which the driver begins to brake before entering a turn and then continues to brake as he eases into the corner. As cornering forces build, the driver gradually feathers off the brakes—trading braking power for cornering grip. By increasing the vertical loading—and thus the traction—at the front tires, trail-braking can improve a car's **turn-in.**

trail breaking—a phenomenon that occurs when the road through the forest turns left and you turn right.

trailing arm—a suspension element consisting of a longitudinal member that pivots from the body at its forward end and has a wheel hub rigidly attached to its trailing end. A sufficiently rigid trailing arm can provide all of a wheel's location. In that case it is similar to a **semi-trailing arm,** except that its pivot axis is exactly perpendicular to the car's longitudinal center line.

trailing link—a suspension **link** that is aligned to resist longitudinal motions in a wheel; it is mounted to the **chassis** ahead of the wheel.

transaxle—a front axle that likes to dress up as a rear axle. Actually, it's a **transmission** and a **differential** combined in one integrated assembly.



TRANSAXLE

transmission—a gearbox with a number of selectable ratios, used to match the engine's rpm and **torque** to differing vehicle requirements.

tread squirm—the flexibility in the tire tread between the surface of the tread and the tire carcass. Snow tires, with their small, deep, unsupported tread blocks, have a large amount of tread squirm. Slick racing tires, which have no tread pattern, have very little squirm.

tube frame—a car frame made up of rigid tubing welded together. Tube frames are easier to manufacture in small quantities than **unitized** frames.

tumblehome—the term that describes the convex curvature on the side of a car body.

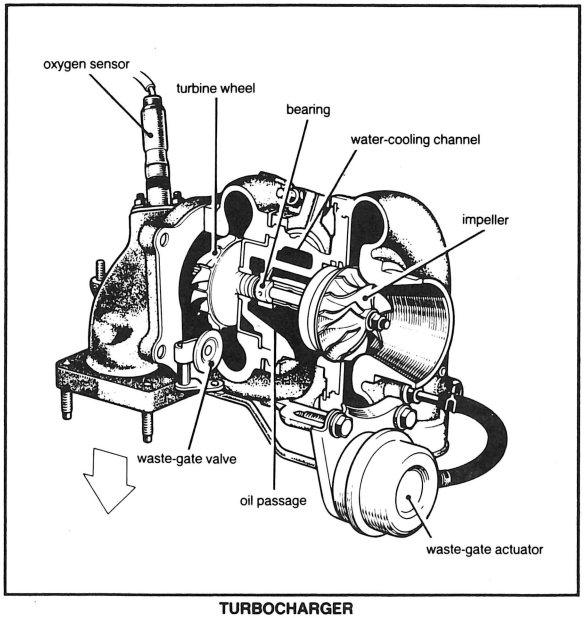
tuned intake and exhaust systems—intake and exhaust systems that, by harnessing the pressure pulses and resonances inside the various passages and chambers of the intake and exhaust manifolds, increase the flow of **intake charge** into and out of the **combustion chambers.**

turbocharger—a **supercharger** powered by an exhaust-driven turbine. Turbochargers always use centrifugal-flow compressors, which operate efficiently at the high rotational speeds produced by the exhaust turbine.

turbo lag—within a **turbocharger's** operating range, lag is the delay between the instant a car's accelerator is depressed and the time the turbocharged engine develops a large fraction of the **power** available at that point in the engine's power curve.

turn-in—the moment of transition between driving straight ahead and cornering.

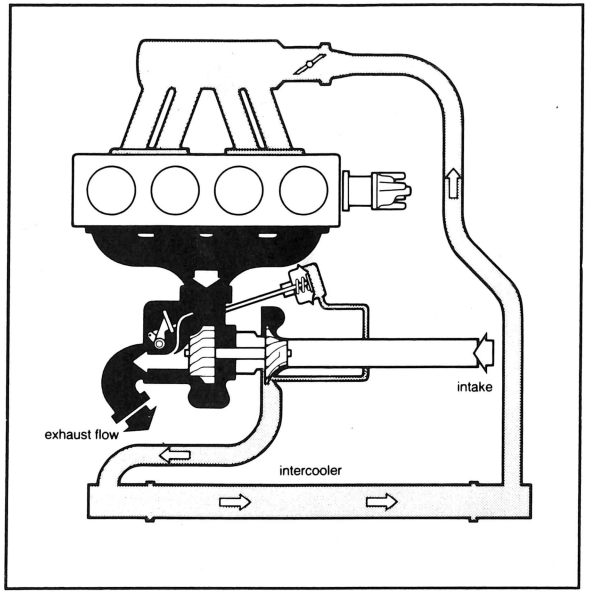
understeer—a **handling** condition in which the **slip angle** of the front tires is greater than the slip angle of the rears. An



TURBOCHARGER

understeering car is sometimes said to **push,** because it resists turning and tends to go straight.

unitized construction—a type of body construction that doesn't require a separate frame to provide structural strength or sup-

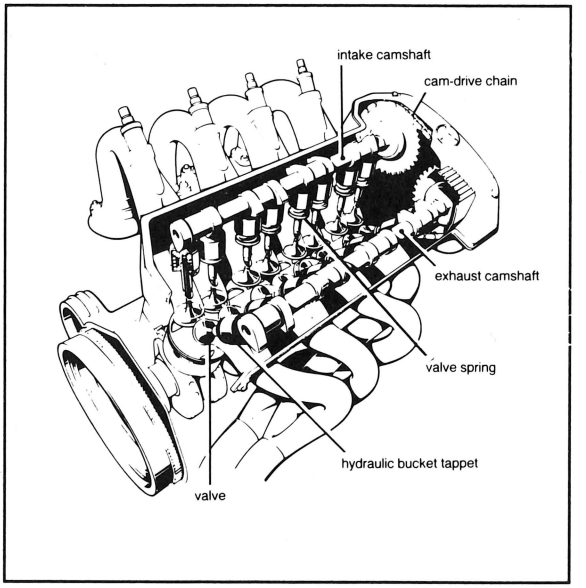


TURBOCHARGER GAS FLOW

port for the car's mechanical components. A unitized body can employ **monocoque** construction, or it can utilize strong structural elements as an integral part of its construction.

universal joint—a joint that transmits rotary motion between two shafts that aren't in a straight line. Depending on its design, a universal joint can accommodate a large angular variation between its inputs and outputs. The simplest kind of universal joint, called a "Hooke joint," causes the output shaft to speed up and slow down twice for every revolution of the input shaft. This speed fluctuation increases with the angular difference between the shafts.

valve float—mix two cups of root beer, a scoop of vanilla ice cream, and add valves to taste. Also, a high-rpm engine condition in which the **valve lifters** lose contact with the cam lobes because the valve springs are not strong enough to overcome the momentum of the various **valvetrain** components. The onset of valve float prevents higher-rpm operation. Extended periods of valve float will damage the valvetrain.

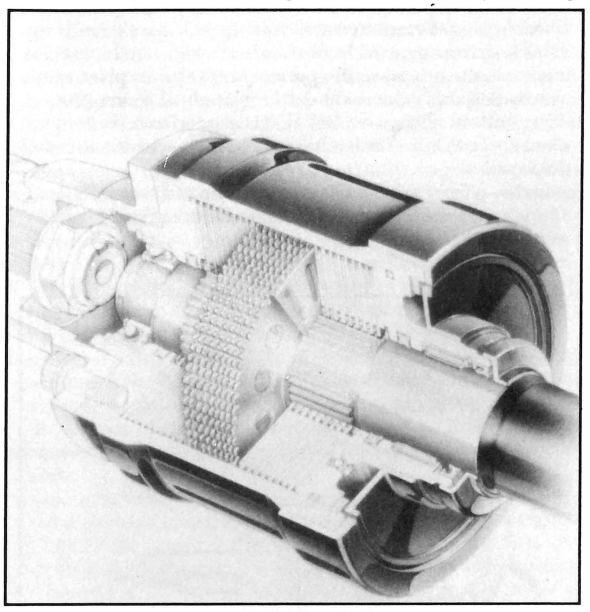


VALVETRAIN

valve lifter—also called a "valve follower"—the cylindrically shaped component that presses against the lobe of a **camshaft** and moves up and down as the cam lobe rotates. Most valve lifters have an oil-lubricated hardened face that slides on the cam lobe. So-called "roller lifters," however, have a small roller in contact with the cam lobe—thereby reducing the friction between the cam lobe and the lifter.

valvetrain—the collection of parts that make the valves operate. The valvetrain includes the **camshaft(s)** and all related drive components, the various parts that convert the camshaft's rotary motion into reciprocating motion at the valves, and the valves and their associated parts.

viscous coupling—a particular kind of **fluid coupling** in which the input and output shafts mate with thin, alternately spaced discs in a cylindrical chamber. The chamber is filled with a viscous fluid that tends to cling to the discs, thereby resisting



VISCOUS COUPLING

speed differences between the two shafts. Viscous couplings are used to limit the speed difference between the two outputs of a **differential,** or between the two axles of a car.

waste gate—a valve used to limit the **boost** developed in a **turbocharger.** A waste gate operates by allowing some of the engine's exhaust flow to bypass the turbocharger's turbine section under certain conditions.

wheel hop—an undesirable suspension characteristic in which a wheel (or several) moves up and down so violently that it actually leaves the ground. Wheel hop can be caused by many problems, including excessive unsprung weight, insufficient shock damping, or poor torsional axle control.

yaw—the rotation about a vertical axis that passes through the car's **center of gravity.**

zero-offset steering—a steering system whose geometry has a **scrub radius** of zero. This configuration minimizes the steering effects produced during acceleration (with front drive) or braking on varying traction surfaces. ●